WORLD ENERGY COUNCIL

Humanising energy

THIRD VIENNA ENERGY STRATEGY DIALOGUE | 24 November 2020

Panel: The socio-economic implications of the global energy transition

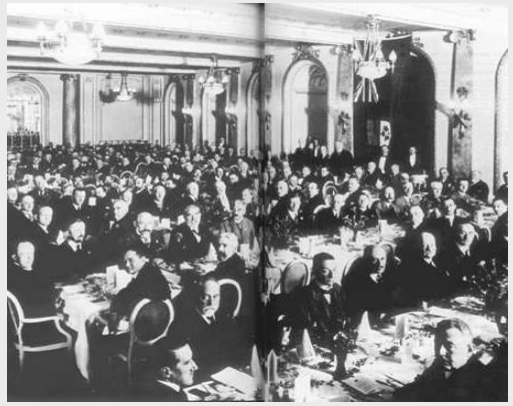
Angela Wilkinson, Secretary General, World Energy Council

Our enduring mission – 100 years of better energy for everyone and everything

- The first permanent **world energy** organisation
- **Open-to-all, impartial, neutral and vehemently independent**
- **3,000 member organisations in nearly 90 countries from across the entire energy industry,** connecting public, private and academic spheres- 'whole' system.
- **Inspire, inform and impact 'how to' -** build and transform by engaging diversity in energy as a source of insight, innovation and learning**.**

"A breath of common sense in a global age" – H G Wells 1924

Global influenza pandemic 1918

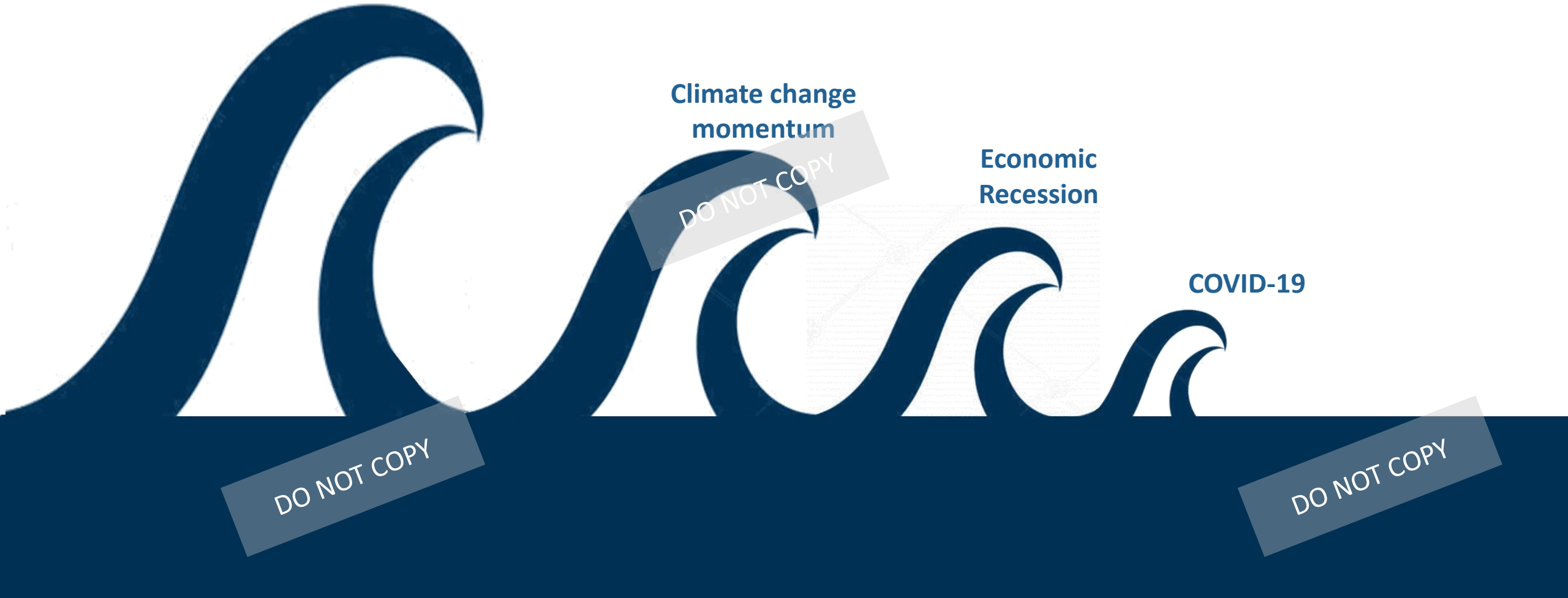


World Power Conference 1924

Great Depression 1929

No crisis happens in a vacuum

The world energy industry was already changing and under pressure to change faster



Recovery in an era of global energy transition…

Sustainable energy is about more energy and less carbon in a new context….

ENERGY FOR PEACE
(Nations)

ENERGY FOR PROSPERITY
(Markets and/or States)

ENERGY FOR PEOPLE & PLANET
(Communities & Networks)

2D GLOBAL DRIVERS:

Diversification of supply
Development of better technologies (electrification)

3D GLOBAL DRIVERS:

Decarbonisation
Decentralisation
Digitalisation

4D GLOBAL DRIVERS:

Decarbonisation
Decentralisation
Digitalisation
Disruption

1923 — Post WW2 — 2022 →

Humanising energy - supporting societies in managing connected challenges

Energy is not a sector, it's the ultimate connector and enabler of human development and progress

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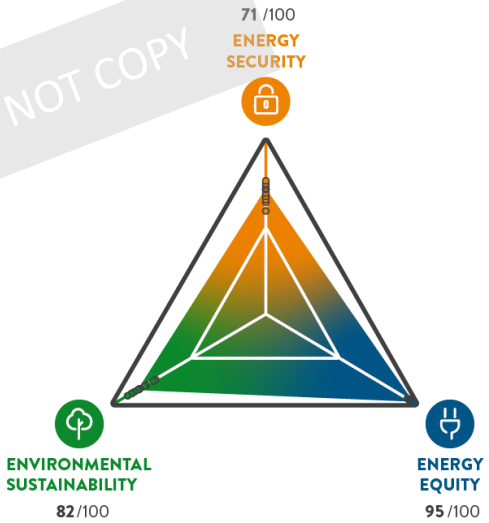
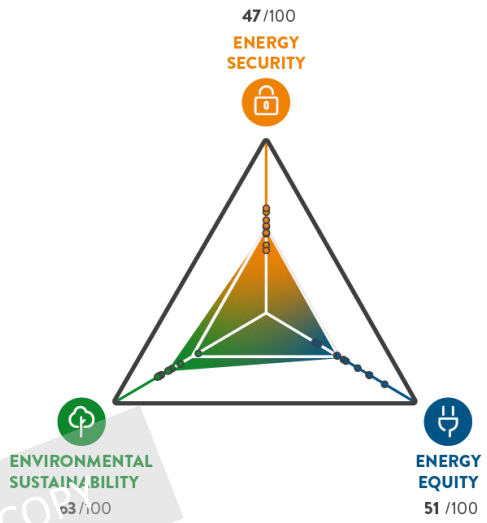
TOP 10 RANK OVERALL PERFORMERS



Rank		Grade	Score
1	Switzerland	AAAa	84.3
2	Sweden	ABAa	84.2
3	Denmark	AAAa	84.0
4	Austria	AAAa	82.1
4	Finland	ABAa	82.1
5	France	AAAa	81.7
5	United Kingdom	AAAa	81.7
6	Canada	AABa	81.5
7	Germany	AAAa	80.9
8	Norway	BAAa	80.5
9	United States	AABa	79.8
10	New Zealand	AAAa	79.5

TOP 10 COUNTRIES OVERALL IMPROVERS



Rank		Grade	Score	Improvement since 2000
91	Cambodia	DDDd	50.8	77%
89	Myanmar	BDCd	54.3	50%
89	Kenya	BDBc	54.3	41%
94	Bangladesh	DDDd	47.8	38%
75	Honduras	CCBc	60.5	36%
88	Ghana	CDBc	55.3	36%
82	Nicaragua	CCBd	57.9	34%
101	Ethiopia	DDCd	43.1	33%
83	Tajikistan	DCCd	57.1	30%
87	Mongolia	DBDc	55.5	28%

‘How to’ recover from crisis *and* progress global energy transition?

Equipping leaders with the tools for decision making under uncertainty

WORLD ENERGY COUNCIL

Community-wide surveys

Covid crisis scenarios (to 2024)

World Energy Transition Radar

Scenario Summits

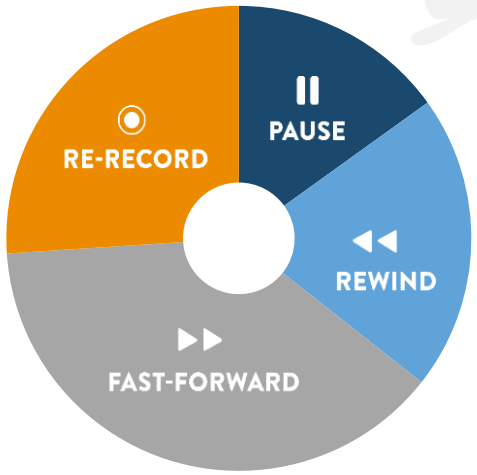
Interactive role play to simulate interaction of leadership choices and actions

World Energy Transition Radar

Real-time signals of recovery and transformation plans and actions

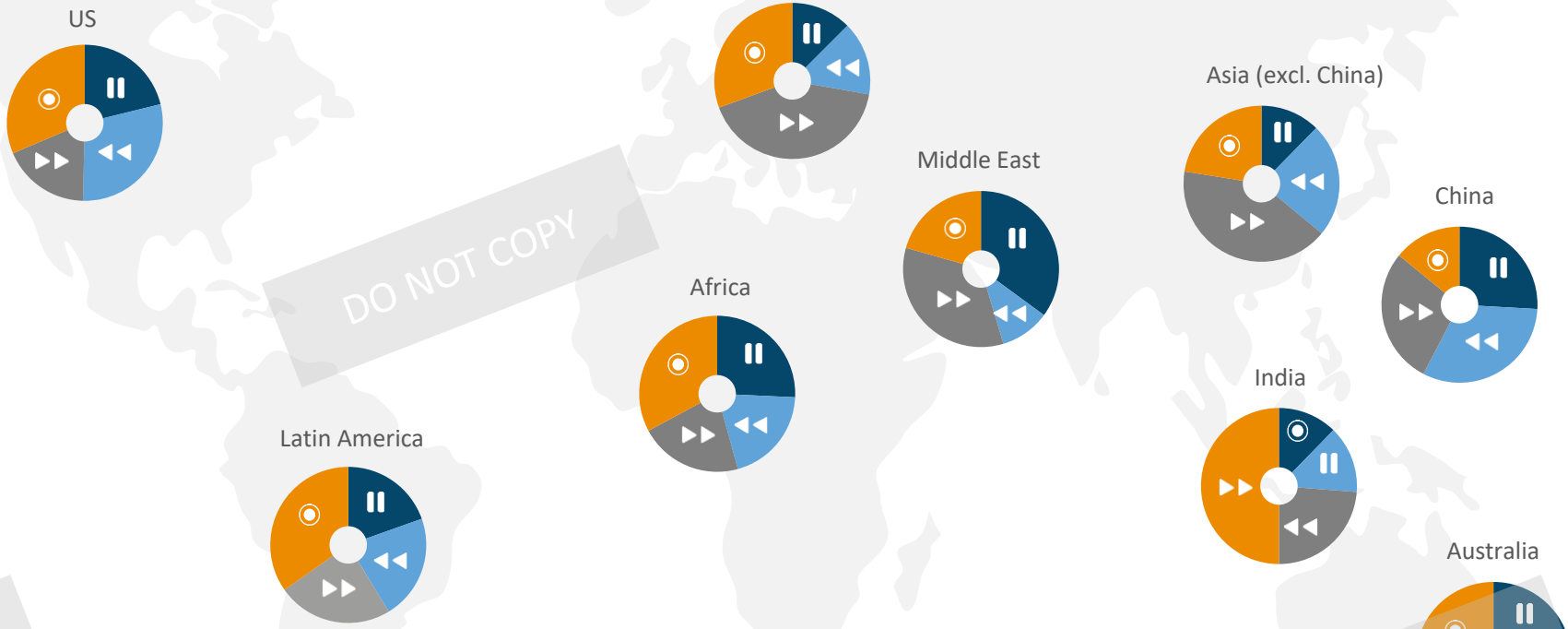
WORLD ENERGY COUNCIL

Global snapshot
(as of 20 November 2020)



Regional geographies snapshots
(as of 20 November 2020)

**regional signals represents approx.. 55% of all signals*



share signals via social media and add relevant hashtag

#WEpause, #WErewind,
#WEforward, #WEreverecord

Anticipating ‘new’ and fast emerging innovation ‘turning points’

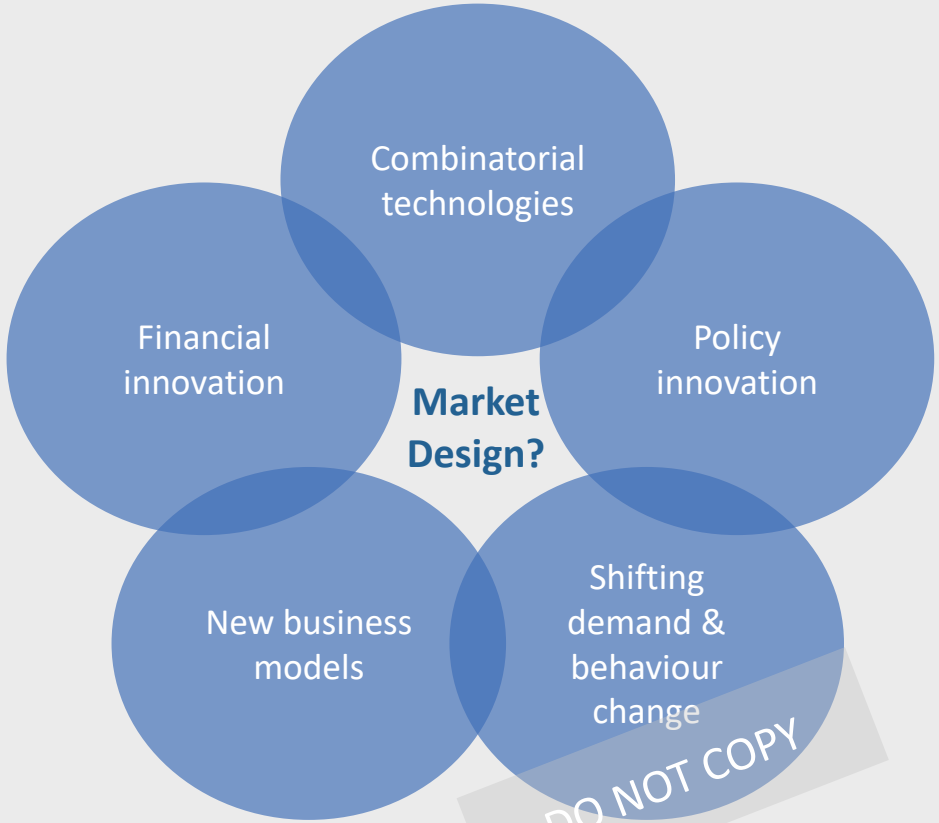
New **geopolitics** of clean energy extends beyond oil and gas:

Clean energy vectors, e.g. hydrogen
(2-10% of final energy by 2040)

Non-energy materials
(lithium, cobalt, etc.)

Data and information

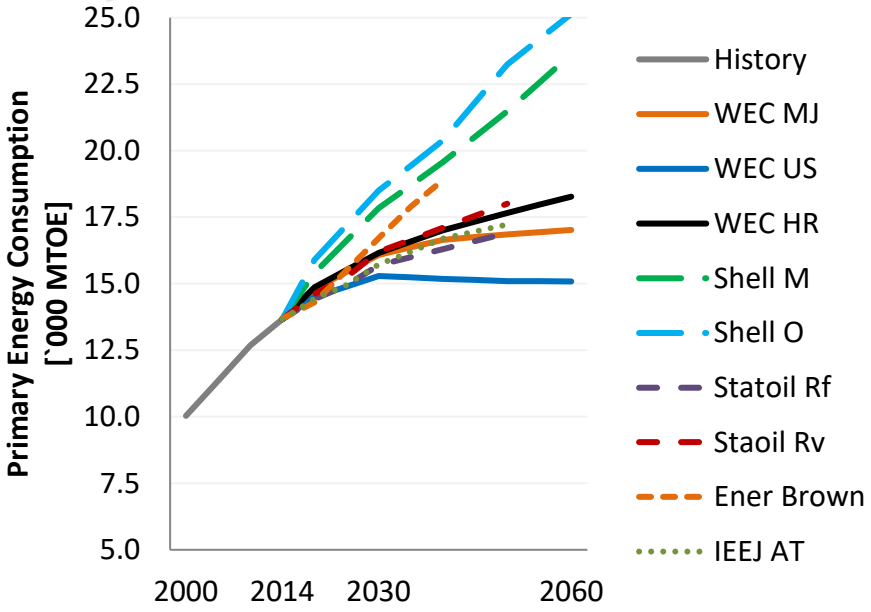
Accelerating pace of innovation
- **constellations of disruptions**



Scenario comparison – demand assumptions

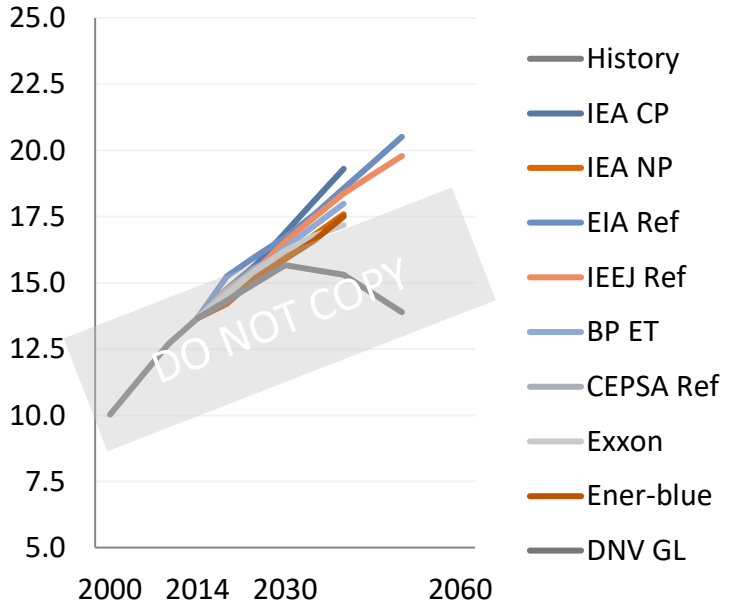
What stories (and assumptions) are you paying attention to?

Plausible Scenarios



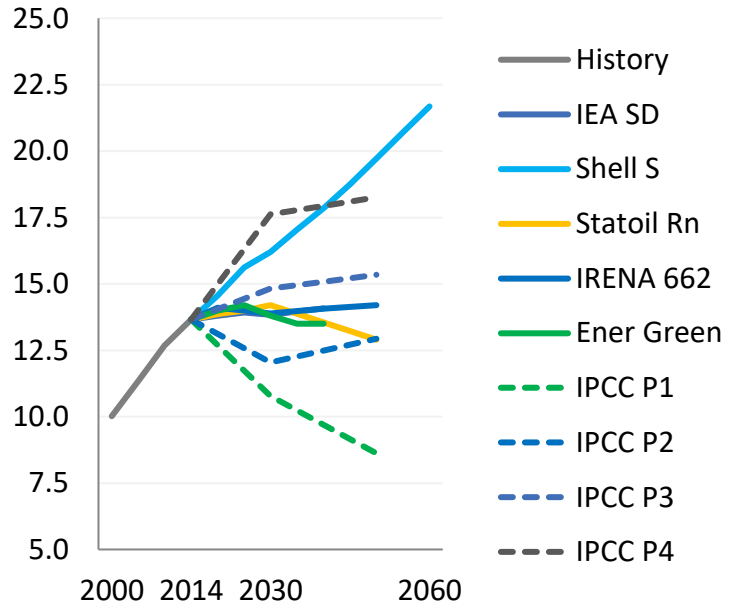
Plausible: WEC MJ (Modern Jazz), WEC US (Unfinished Symphony), WEC HR (Hard Rock), Shell M (Mountain), Shell O (Ocean), Statoil Rf (Reform), Statoil Rv (Rivalry), Ener-Brown, IEEJ AT (Advanced Technology)

Outlooks



Outlooks: IEA CP (Current Policies), IEA NP (New Policies), EIA Ref (Reference), IEEJ Ref (Reference), BP (Evolving Transition), CEPSA Ref (Reference), Exxon (Reference), Ener-Blue, DNV GL

Normative Scenarios

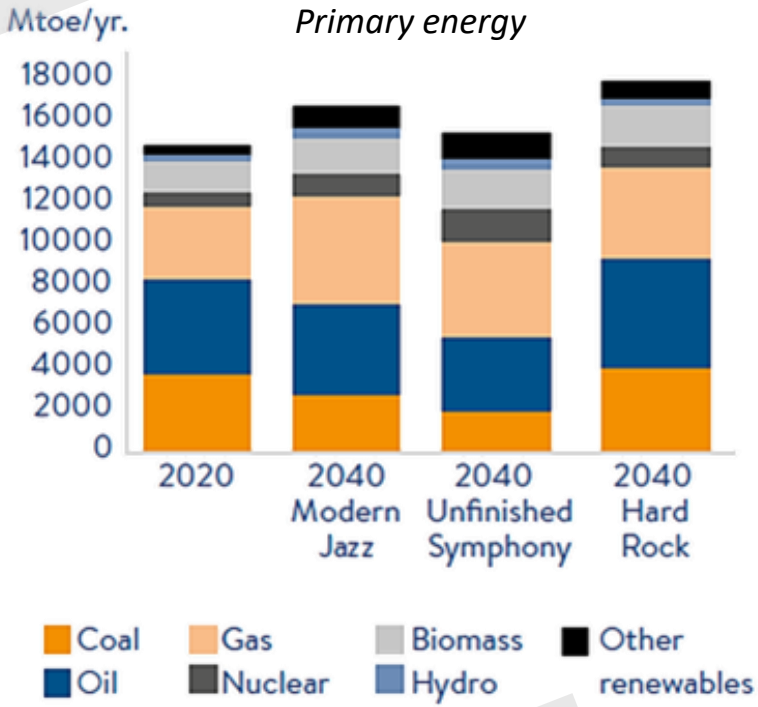


Normative: IEA SD (Sustainable Development), Shell S (Sky), Statoil Rn (Renewal), IRENA 662 (66% below 2°C), Ener-Green, IPCC P1 (Low Energy Demand), IPCC P2 (Sustainability), IPCC P3 (Middle of the Road), IPCC P4 (Fossil-Fuelled Development)

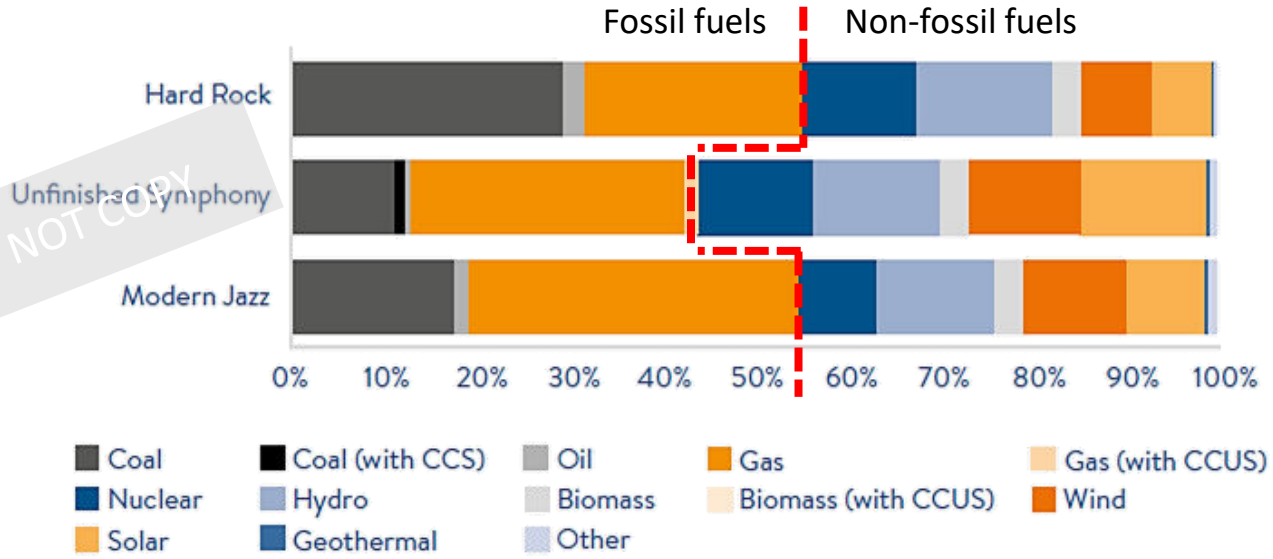
World Energy Scenarios to 2040

Renewable electrification is part of a much bigger energy story…

Primary energy



Sources of electricity generation by 2040 (%)



Source: The World Energy Council, Paul Scherrer Institute, Accenture Strategy

Vision 2025 – Humanising energy

INSPIRE

INFORM

IMPACT

WORLD ENERGY COUNCIL | 25th CONGRESS
St. Petersburg, 24-27 October, 2022

'ENERGY FOR HUMANITY'

WE | TALKS

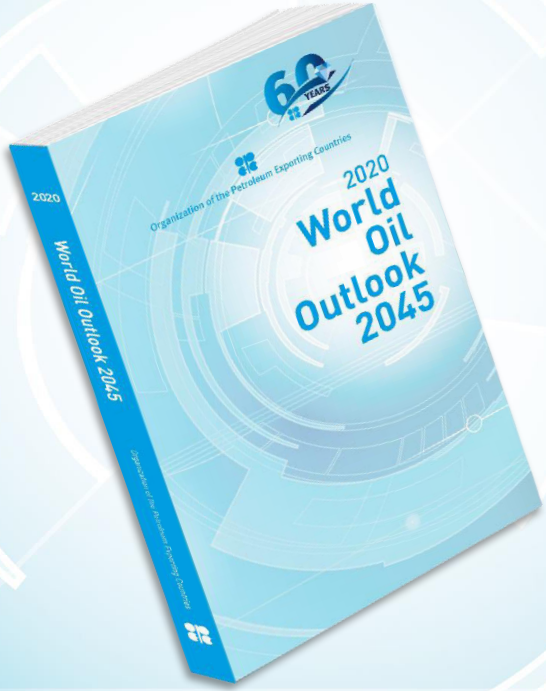
WORLD ENERGY BOOKS
Children energy literacy

WORLD ENERGY COUNCIL

Thank you

Organization of the Petroleum Exporting Countries

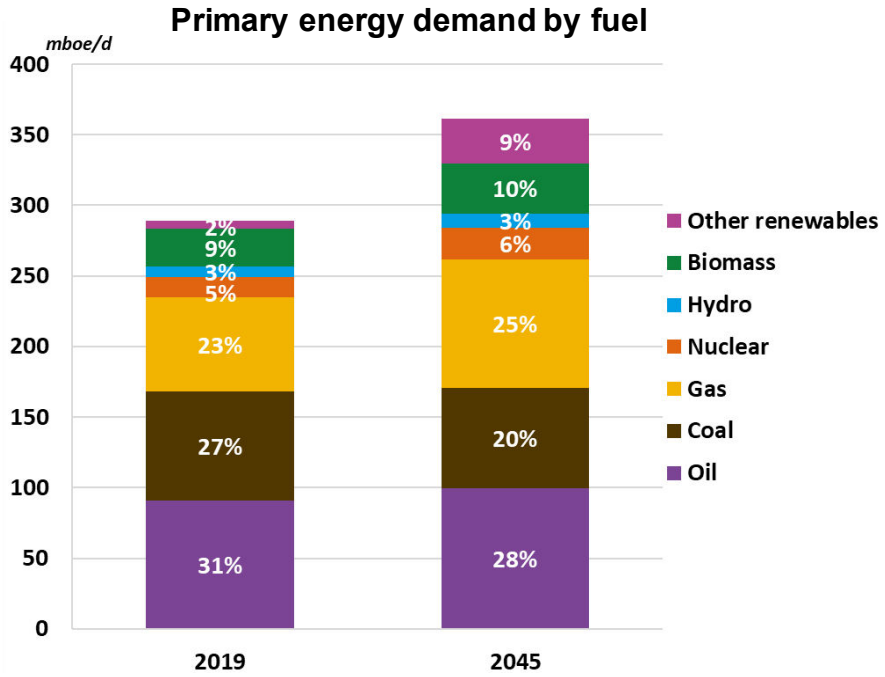
World Oil Outlook 2045

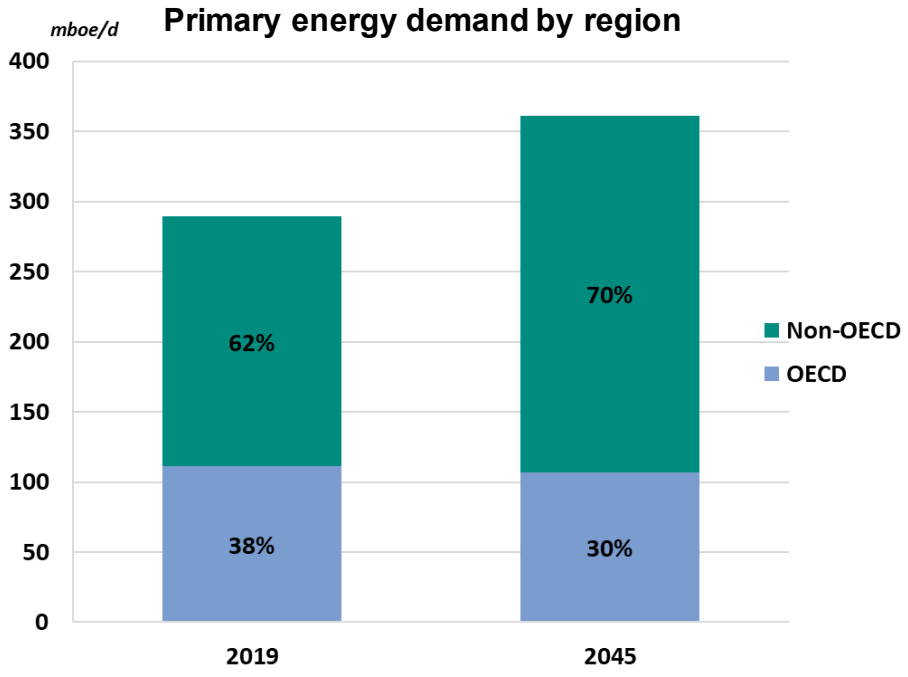


Third Vienna Energy Strategy Dialogue

Presented by OPEC Secretariat
24 November 2020

All energy sources needed to meet future demand, fuel economic growth, and eradicate energy poverty

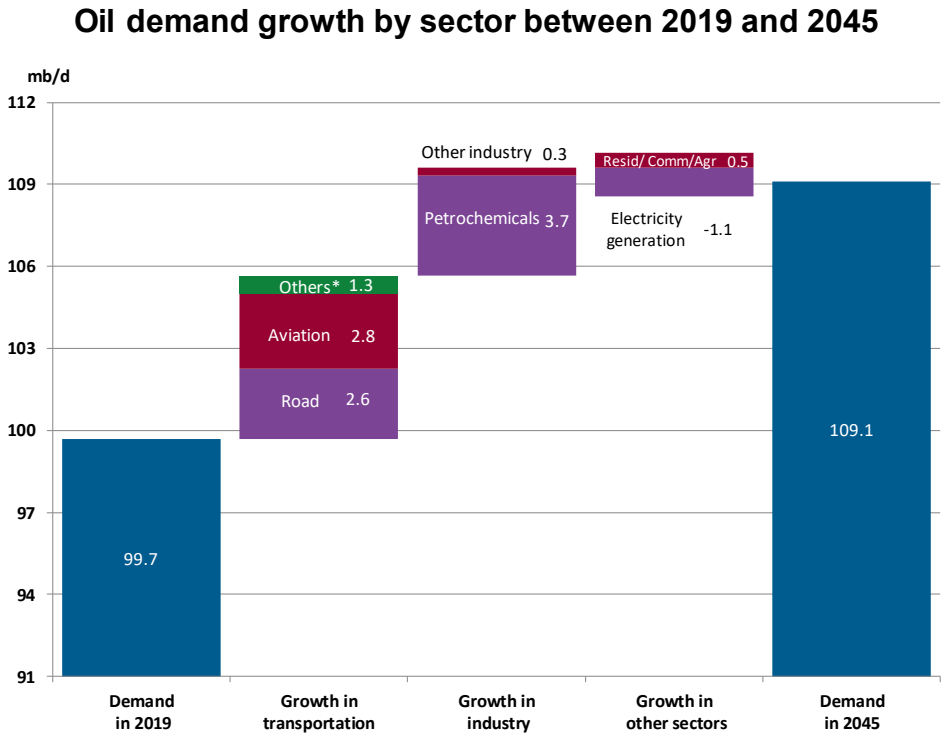




- Global energy demand projected to increase by around 25% between 2019 and 2045
- Demand increases in **non-OECD regions** but drops in **OECD**

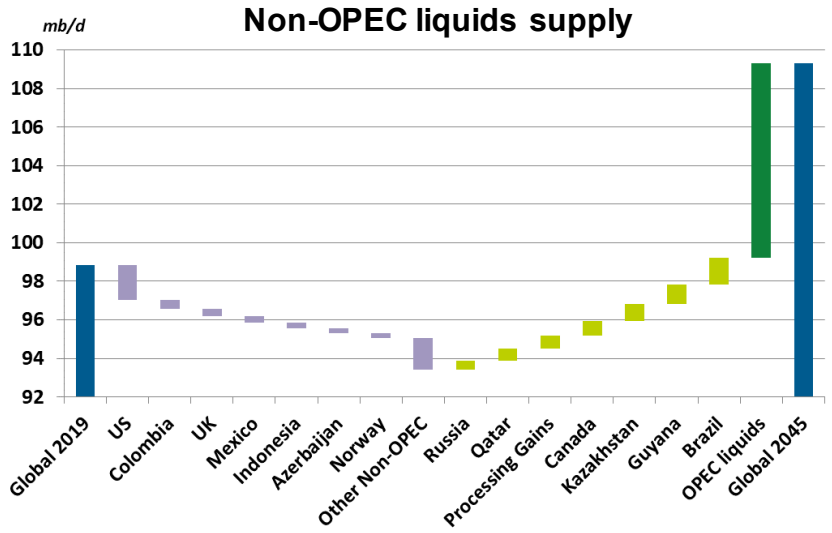
Transport & petrochemicals remain key to future demand

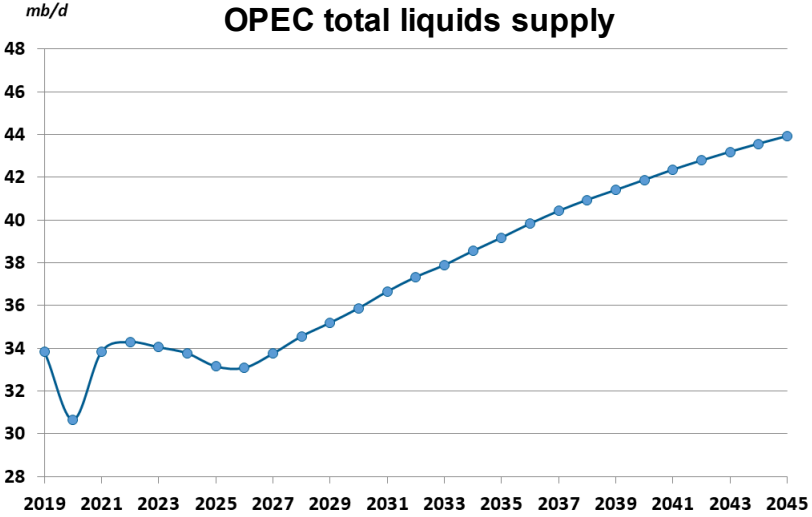
- Various **transport** modes will continue providing basis for oil demand growth
  - Aviation sector **+2.8 mb/d**
  - Road transport **+2.6 mb/d**
  - Marine bunkers **+0.8 mb/d**
- **Petrochemicals** will be the largest incremental demand (**+3.7 mb/d**)
- Some demand increase also in "other industry" and "res./comm./agriculture"
- **Electricity generation** demand is expected to decline by more than 1 mb/d



*Marine bunkers, rail and domestic waterways

Ample scope for OPEC total liquids supply

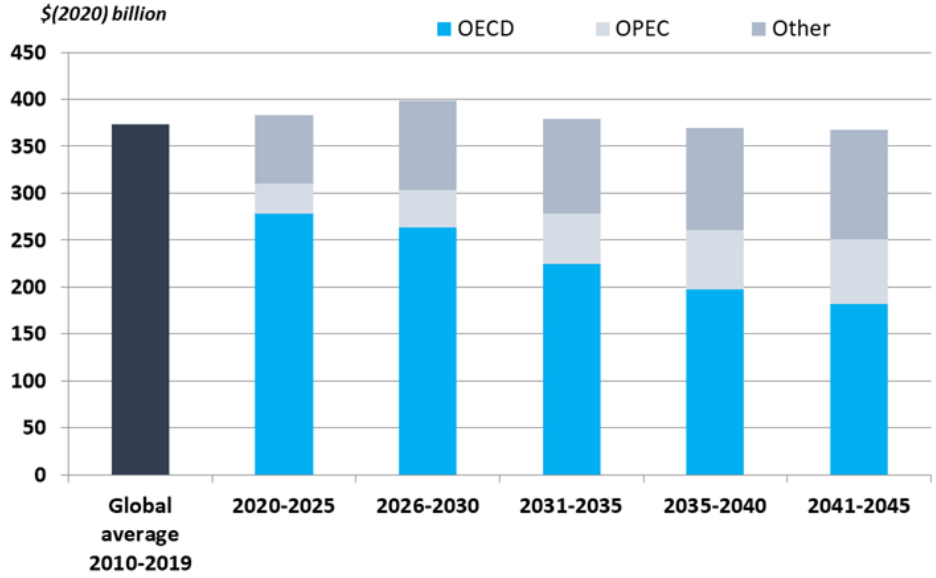




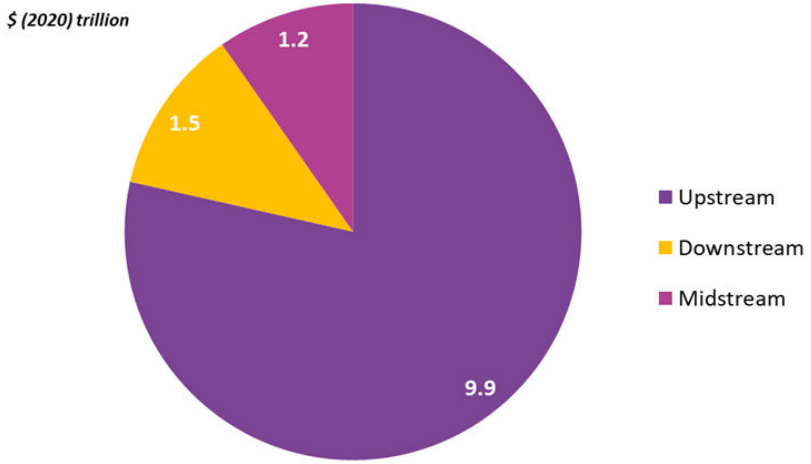
- After 2020 sharp decline, **non-OPEC liquids supply** in medium-term **to recover from pandemic-related shut-ins**
- Few non-OPEC producers to see growth beyond late 2020s, resulting in supply to return almost to 2019 levels
- Over long-term, **OPEC liquids will fill the gap, growing from 34 mb/d in 2019 to 44 mb/d by 2045**

Cumulative oil-related needed investments ~$12.6 trillion

Annual upstream investment requirements



Cumulative oil-related investment requirements 2020–2045



- Recent **drop in global upstream investments** is a **major concern**
- **Upstream** spending needs to average **$380 billion per year**

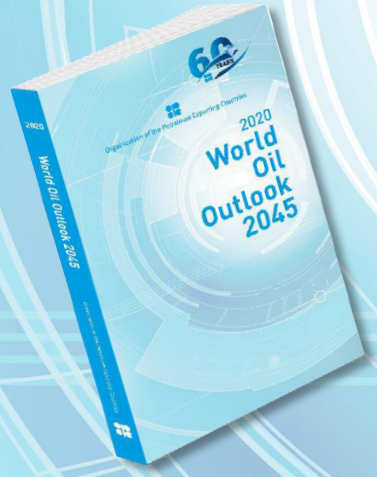
Organization of the Petroleum Exporting Countries

Available as:

Book

Interactive version

Smart app



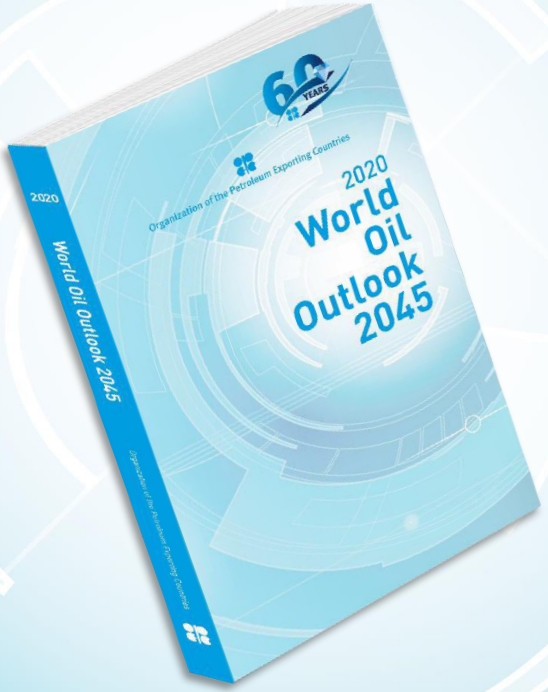
Available for iOS and Android

Download on the App Store

GET IT ON Google Play

Organization of the Petroleum Exporting Countries

Thank you.



www.opec.org

The World in 2050 (TWI2050.org)

COVID-19 RESPONSE

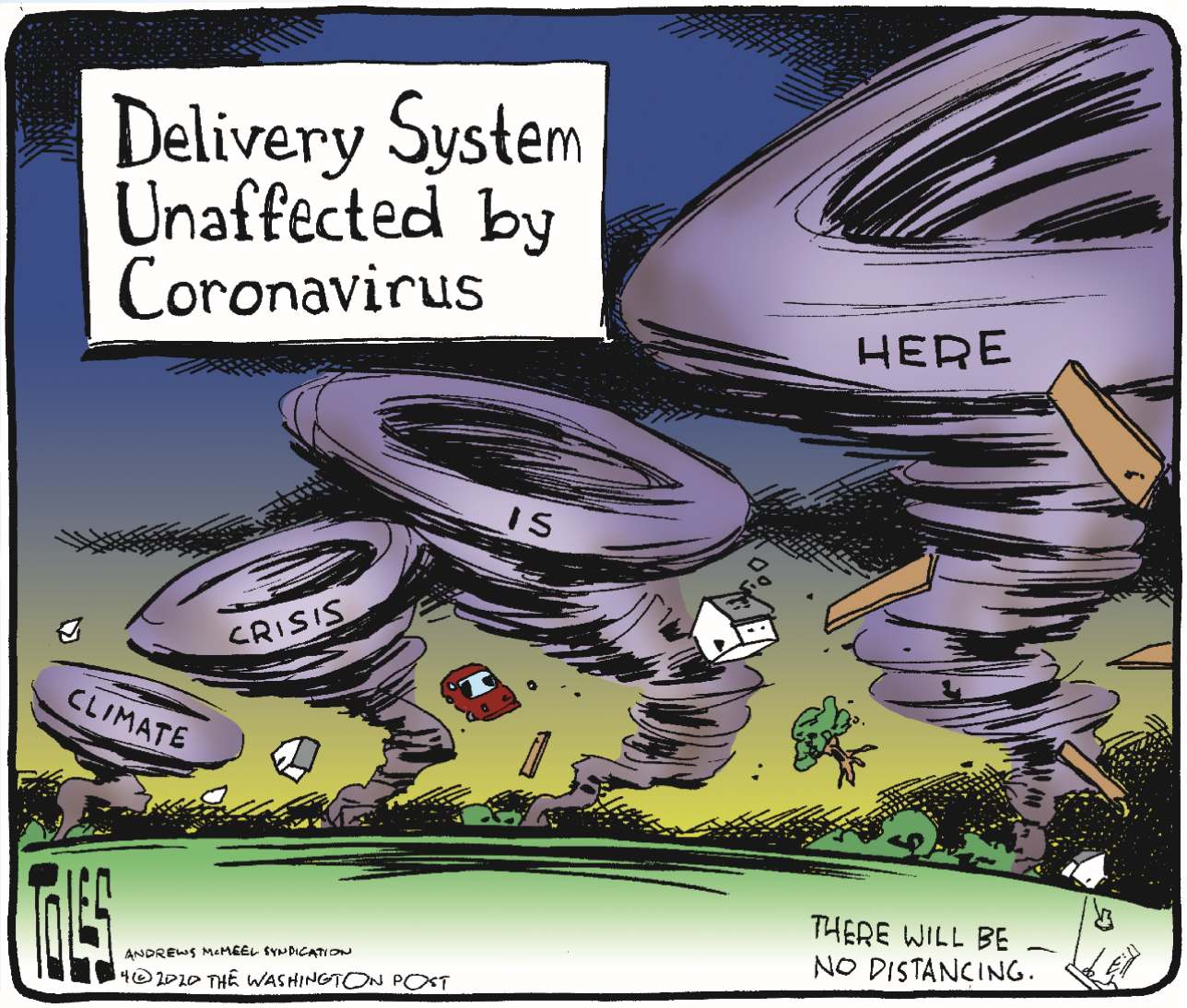
Nebojsa Nakicenovic

Executive Director of TWI2050

Group of Chief Scientific Advisors to European Commission

Former Deputy General of IIASA

Despite the major immediate threat of the COVID-19, the climate crisis is here and also injustice, inequity, and ever-increasing pressure on Earth systems and global commons.



The World is at "Crossroads"

Explosive development transgressing planetary boundaries but many left behind

- Global economy increased 100 fold, energy 50 times and CO_2 30 times
- Temperature increase over 1^{o}C, about 8 million die due to indoor and regional air pollution
- Achievement of Paris Agreement would bring multiple co-benefits for people and the planet


UN DESA and UNFCCC conference on synergies between the SDGs and the Paris Agreement – 1-3 April 2019

Six Major Transformations (TWI2050.org)

Digital Revolution

Human capacity Demography & Health

Smart Cities & Mobility

SDGs:
Prosperity
Social Inclusion
Sustainability

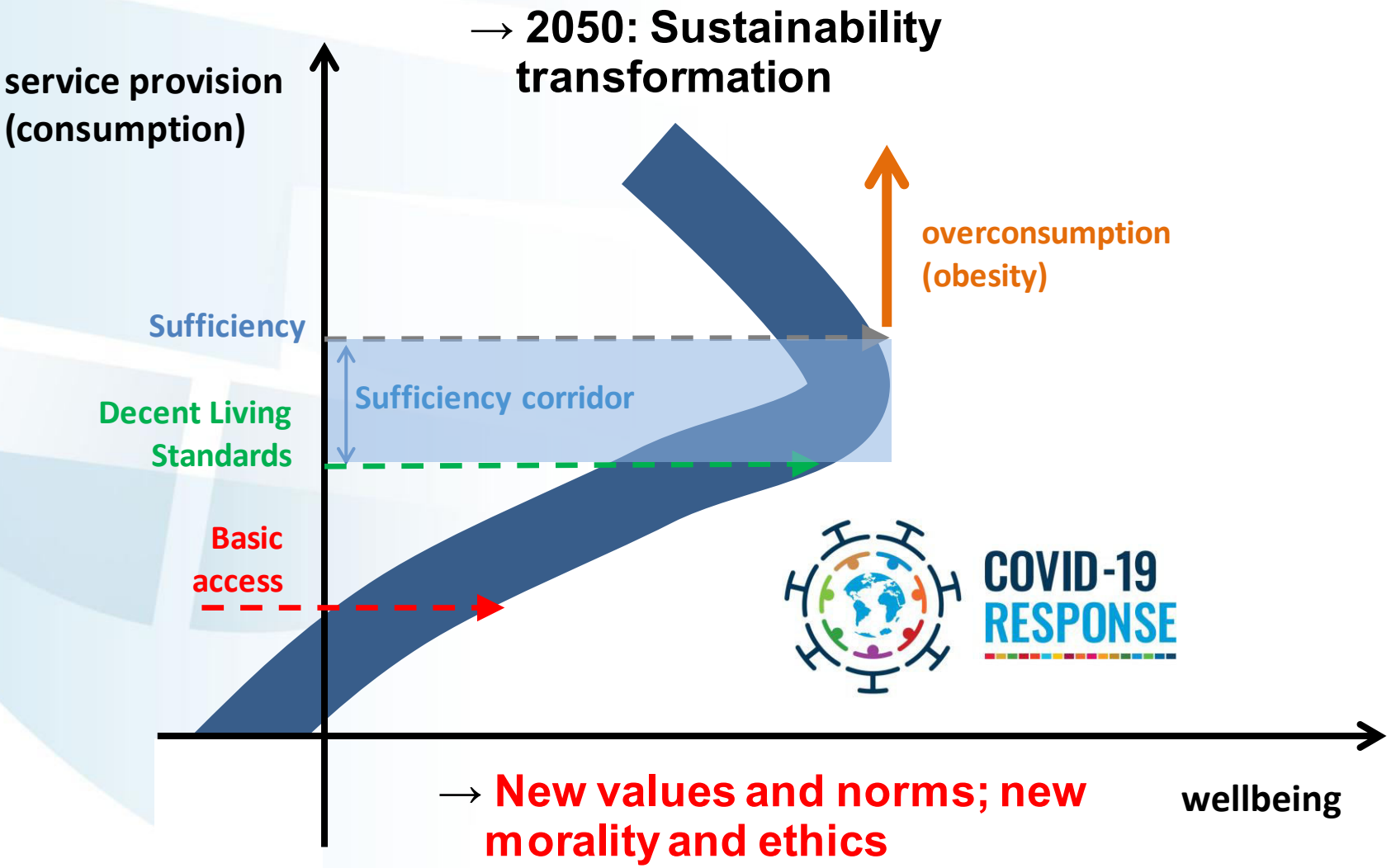
TWI2050
The World in 2050
www.twi2050.org

Consumption & Production

Food, Biosphere & Water

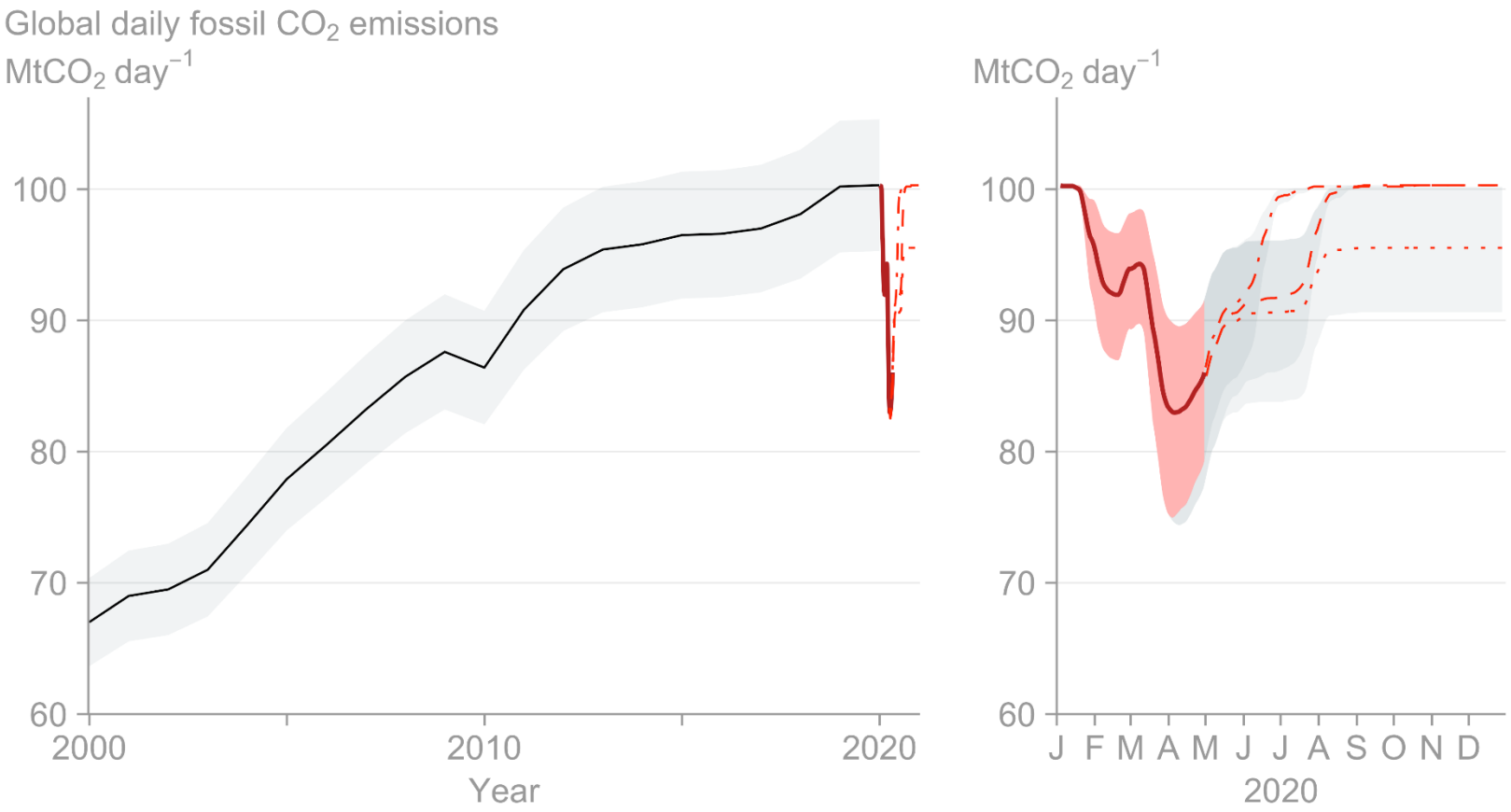
Decarbonization & Energy

Basic needs, Decent living & Sufficiency



Global Fossil CO_2 Emissions

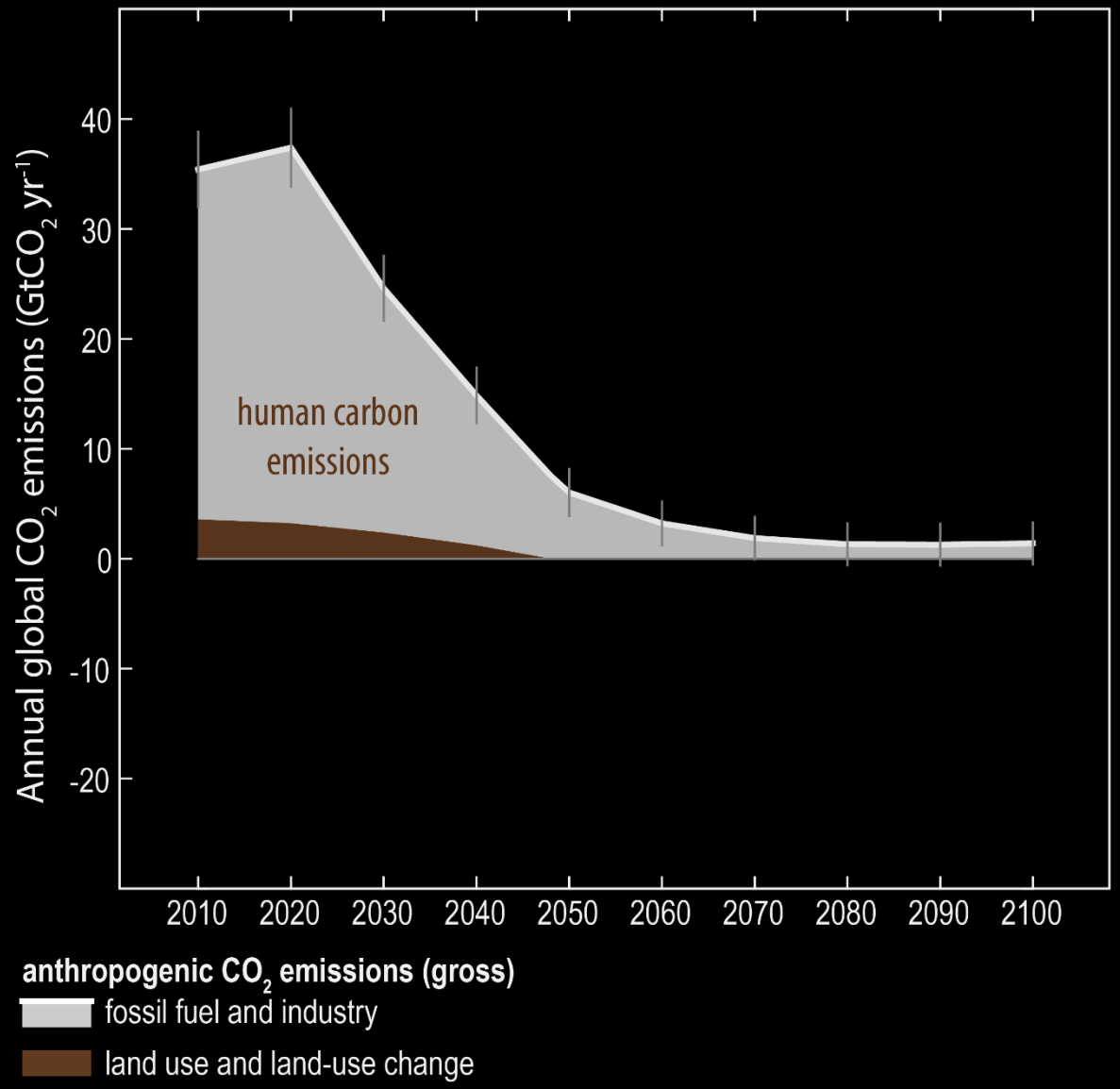
Global fossil CO_2 emissions: 36.6 ± 2 $GtCO_2$ in 2018, 61% over 1990
Projection for 2019: 36.8 ± 2 $GtCO_2$, 0.6% higher than 2018 (range -0.2% to 1.5%)
Fossil CO_2 emissions will likely be more than 4% higher in 2019 than the year of the Paris Agreement in 2015



Source: Le Quéré et al. Nature Climate Change (2020); Global Carbon Project

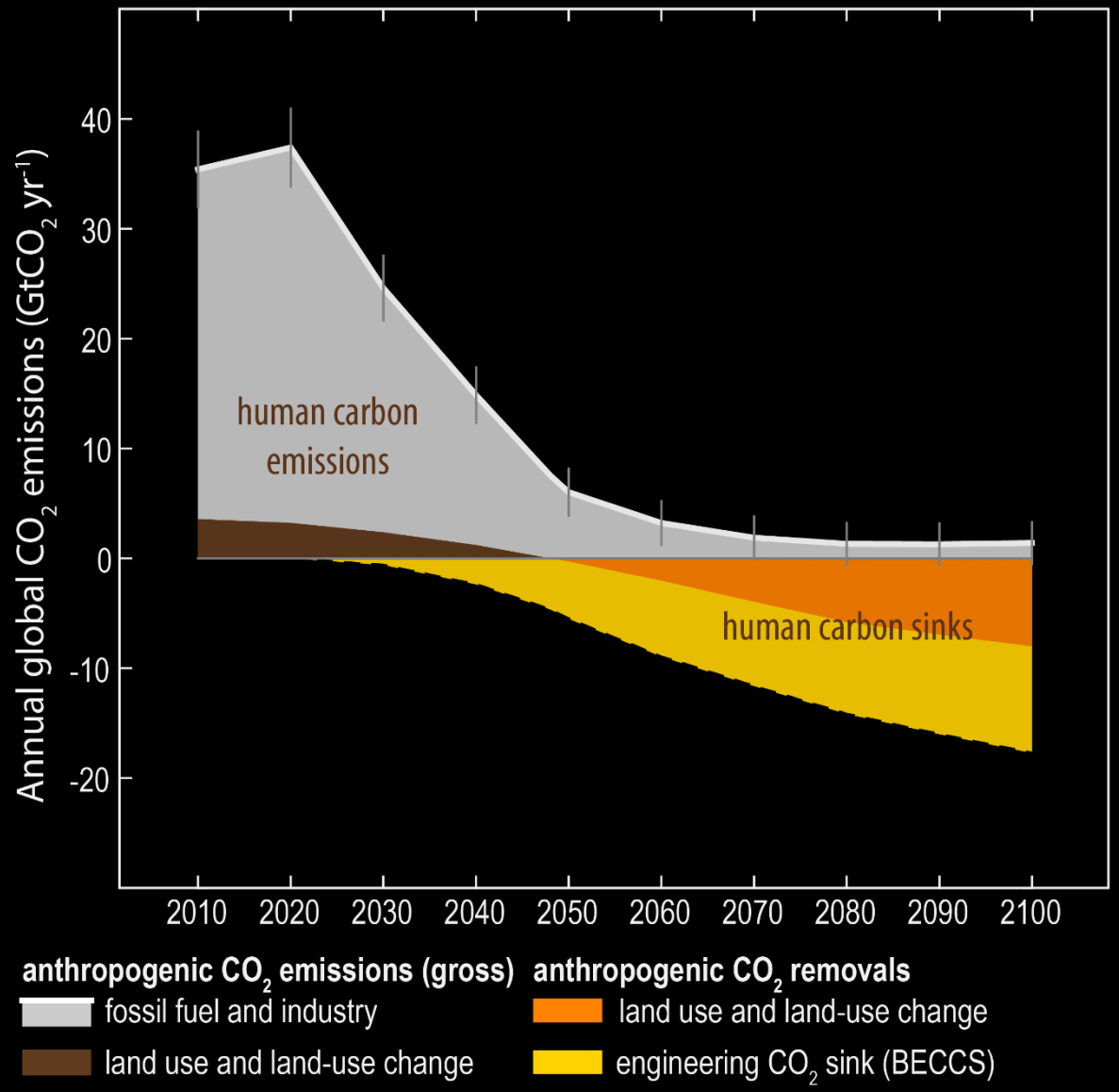
The 2019 projection is based on preliminary data and modelling.
Source: CDIAC; Friedlingstein et al 2019; Global Carbon Budget 2019

“Carbon Law”



Rockström, Gaffney, Rogelj, Meinshausen, Nakicenovic, Schellnhuber. *Science* 24 March 2017

“Carbon Law”



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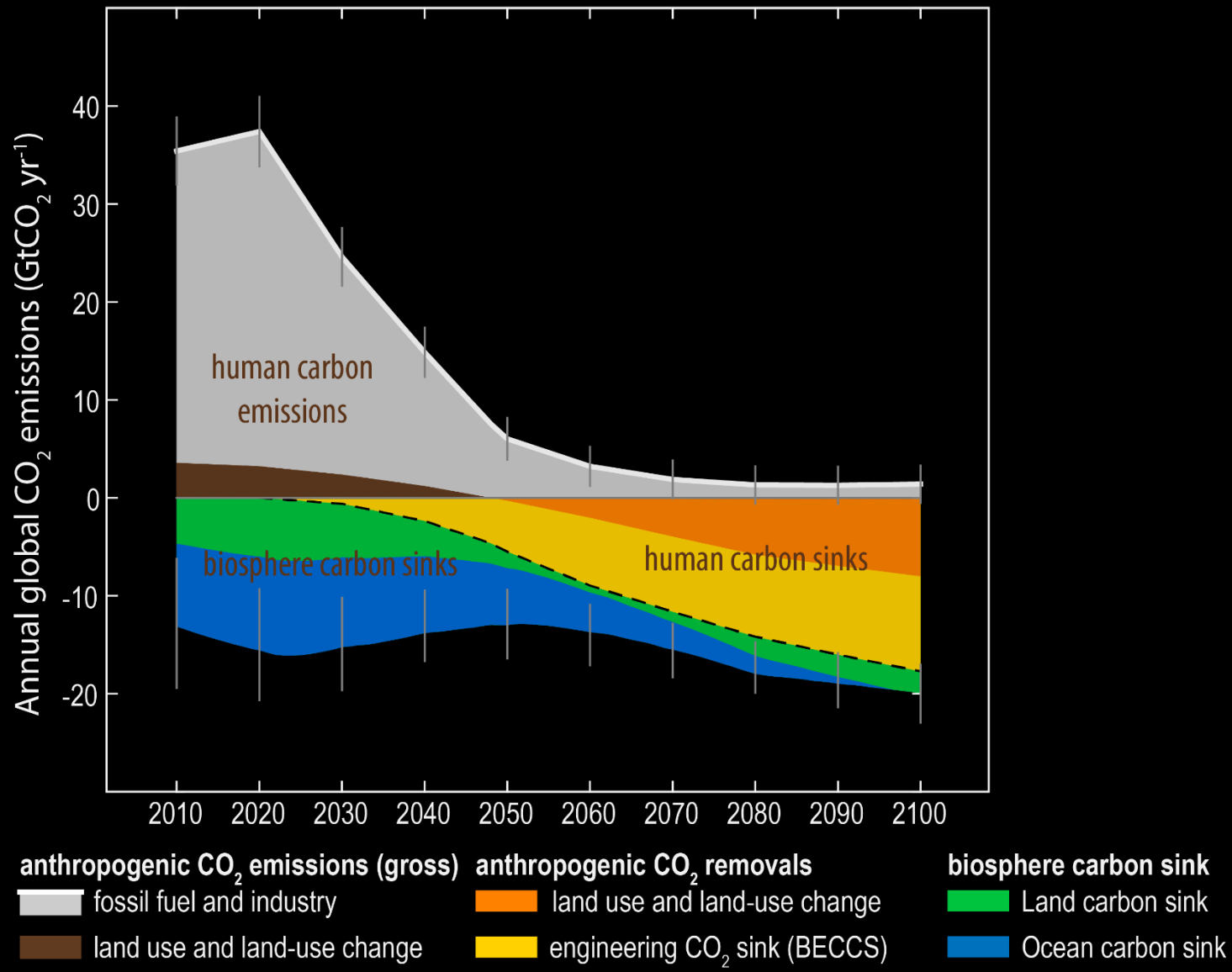
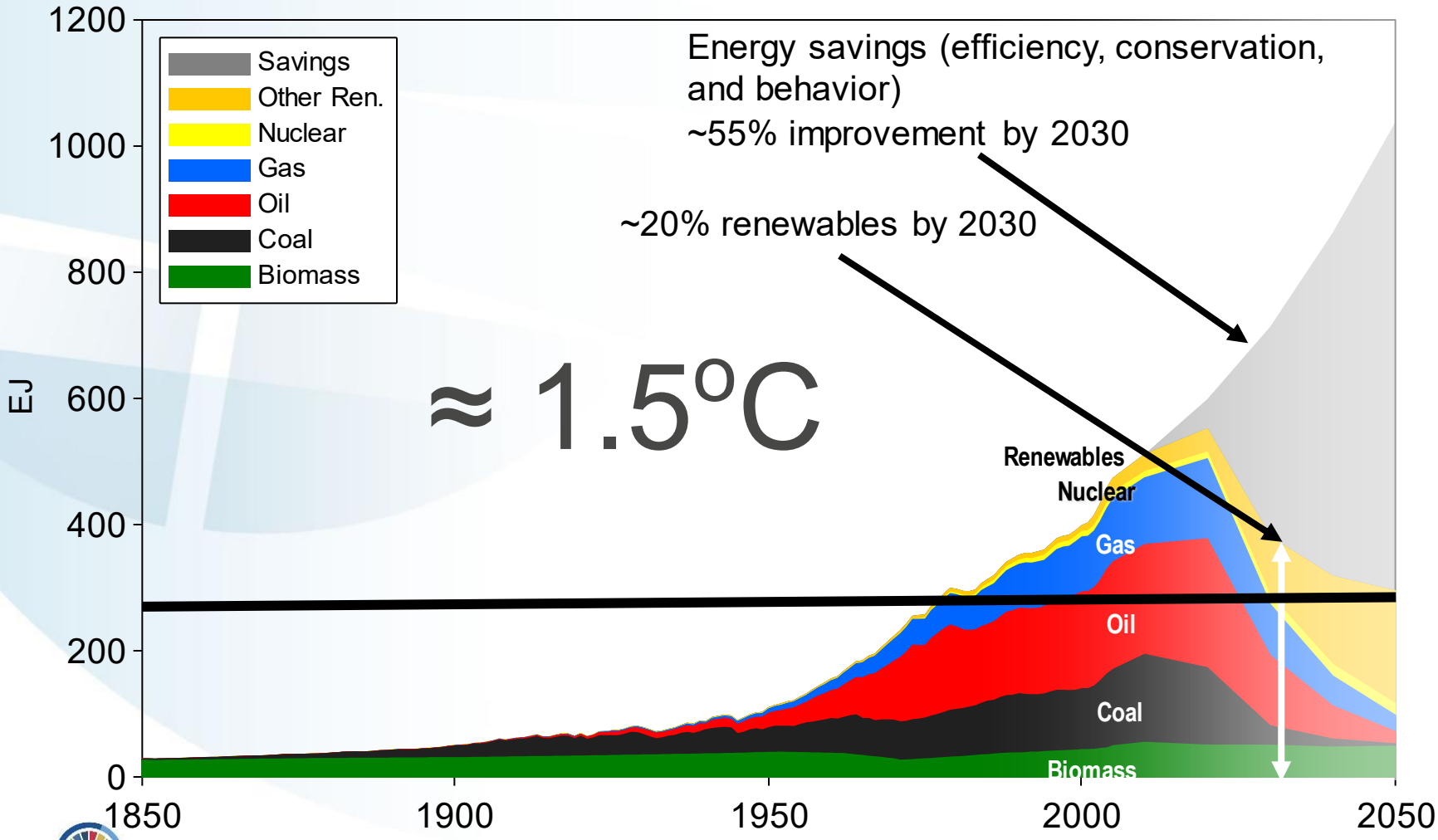


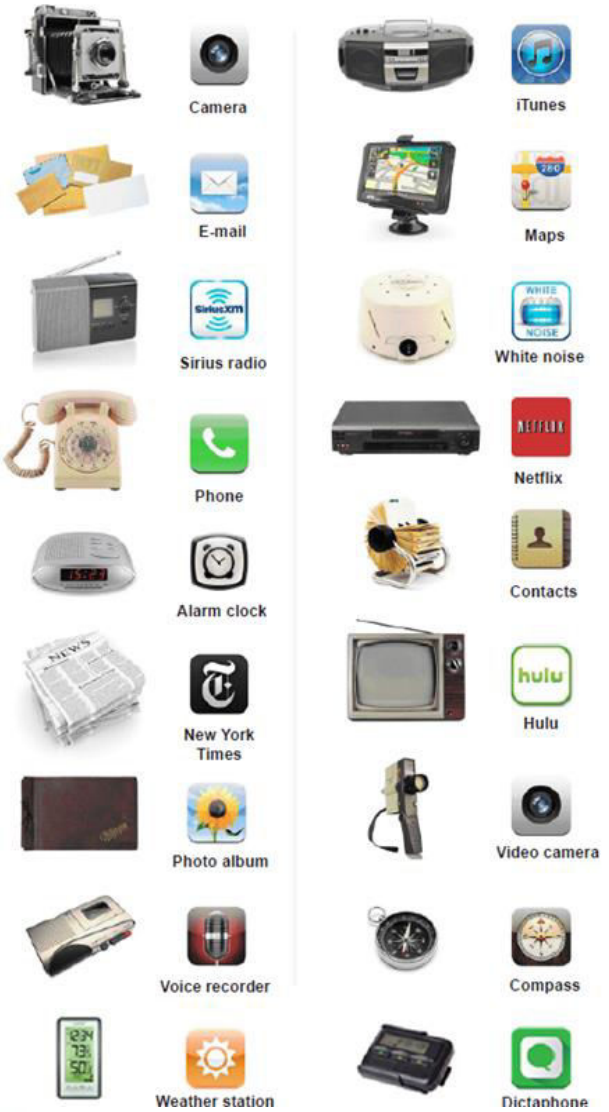
Rockström, Gaffney, Rogelj, Meinshausen, Nakicenovic, Schellnhuber. *Science* 24 March 2017

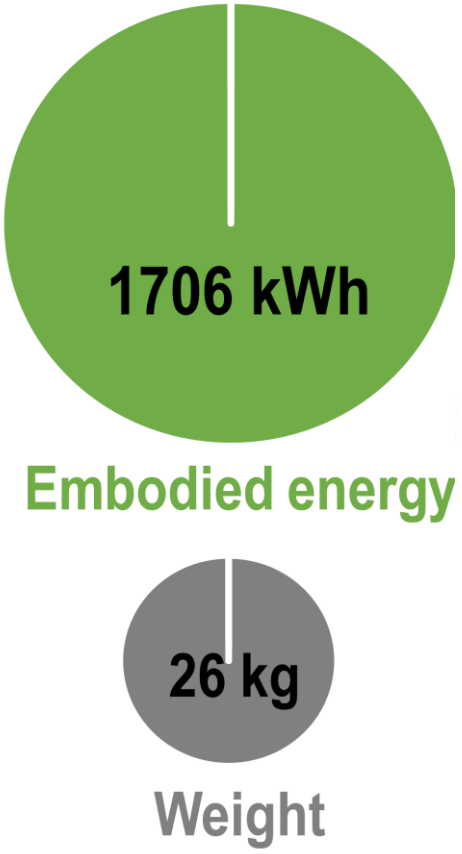
Global Primary Energy

ALPS Low Energy Demand (LED)

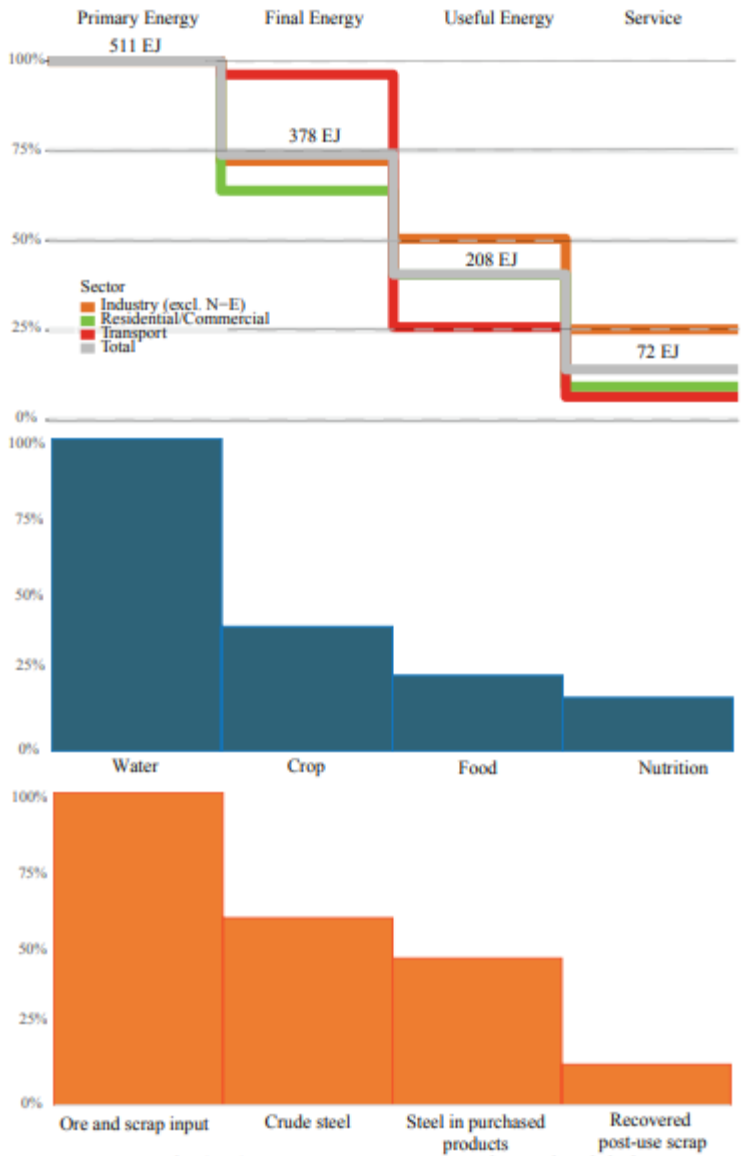


Disruptive End-Use Innovations





End-use and Supply Efficiencies and Upstream Leverage Effect of Savings at Service Level



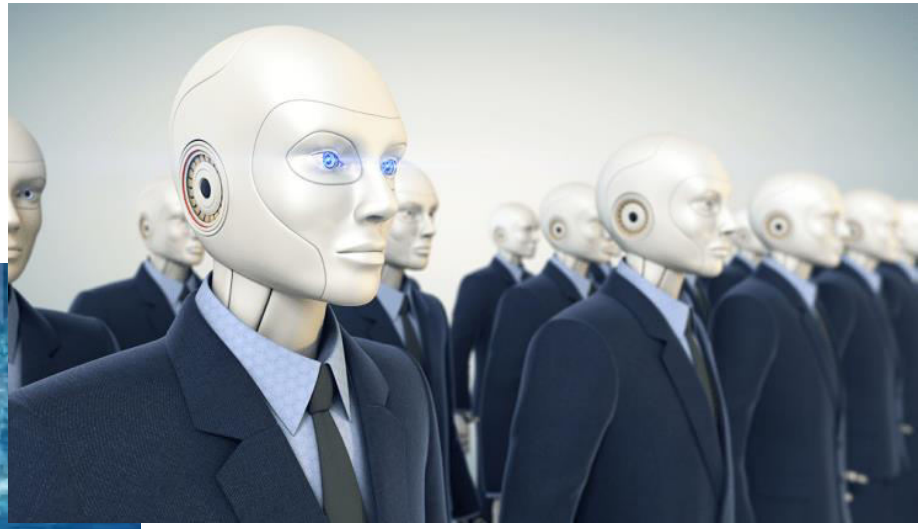
Energy (all services)
aggr. eff.: 14%
1 EJ saved =
7 EJ primary energy

Water (ex. irrigation)
aggr. eff.: 17%
1 m^3 saved =
6 m^3 water withdrawn

Materials (ex. steel)
aggr. eff.: 13%
1 ton saved =
8 tons ore mined

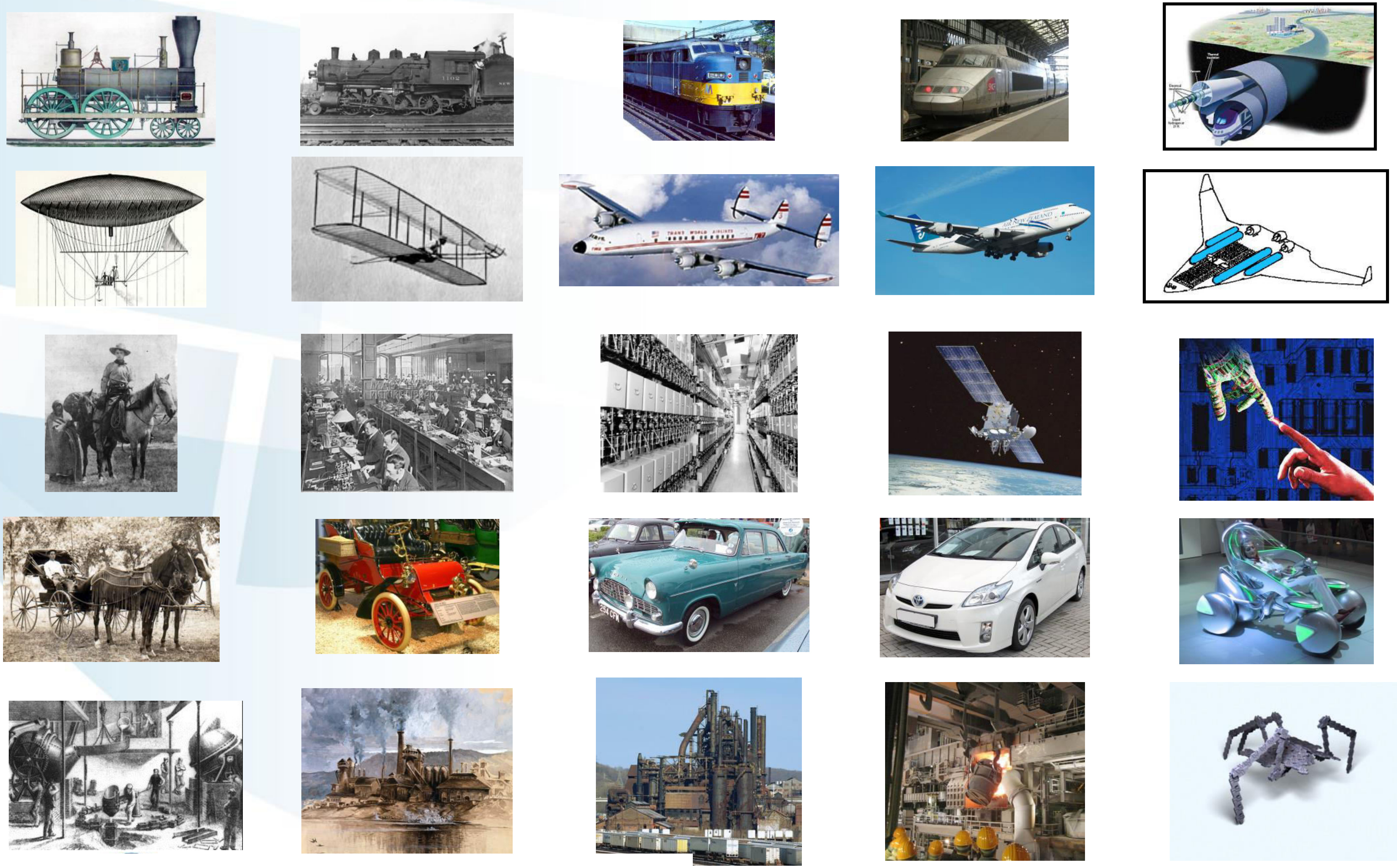
Digital Revolution – Convergence

Artificial Intelligence, Deep Learning, Big Data, Robotics, Nanotechnology, Quantum Computing, Synthetic Biology The Internet of Things, 3D Printing, Block Chain, Autonomous Vehicles, Augmented Reality



Transformational Change

1850 1900 1950 2000 2050



Source: After Granger Morgan, 2013

The World in 2050 (www.TWI2050.org)

- The world is at a crossroads – achievement of the 2030 Agenda is possible but requires accelerated action and transformative pathways for sustainable development.
- The COVID-19 pandemic is a great threat to humanity – but it provides an opportunity for change and innovation toward sustainability.
- Granular, small-size innovations generally have faster adoption and diffusion – they can enable rapid change, but require sustained investments.

International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

science for global insight

THANK YOU

www.TWI2050.org

naki@iiasa.ac.at

IIASA, International Institute for Applied Systems Analysis

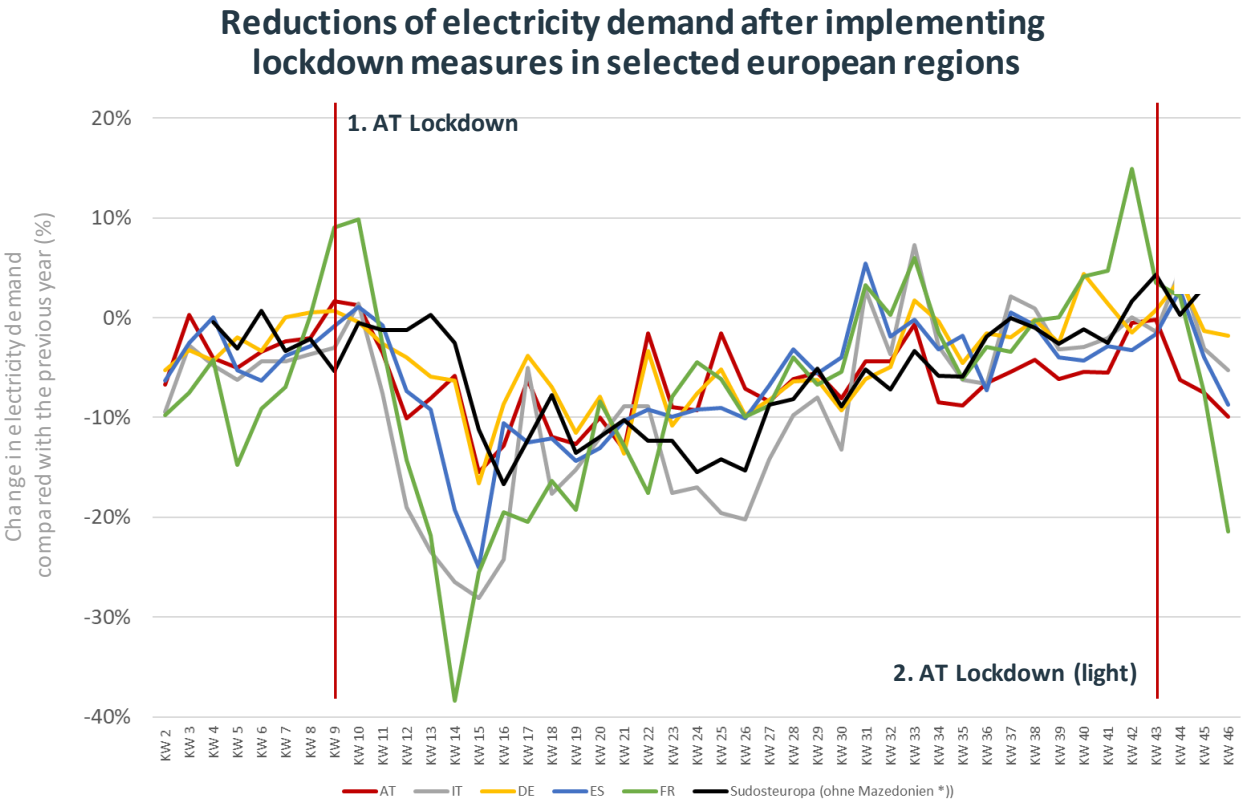
PANEL I: THE SOCIO-ECONOMIC IMPLICATIONS OF THE GLOBAL ENERGY TRANSITION

THIRD VIENNA ENERGY STRATEGY DIALOGUE - The Implications of the Global Energy Transition

DI Mag.(FH) Gerhard Christiner
CTO Austrian Power Grid AG

Vienna, 24.11.2020

Electricity demand reduction in a pandemic-stricken world

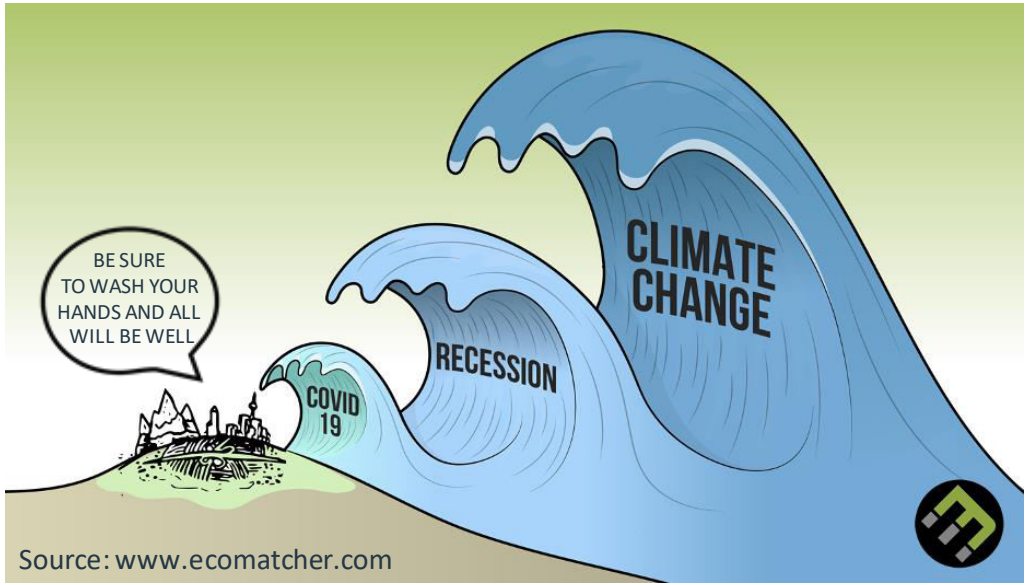


AT - electricity demand reduction YTD[2]: **6-7%**

Global CO_2 emissions are expected to **decline by 8%** in 2020[3]

[1] Source: ENTSO-E Transparency Platform
[2] 1.1.-8.11.2020
[3] IEA 08/2020; https://www.iea.org/reports/global-energy-review-2020/global-energy-and-co2-emissions-in-2020

COVID-19 is awful. Climate change could be worse.



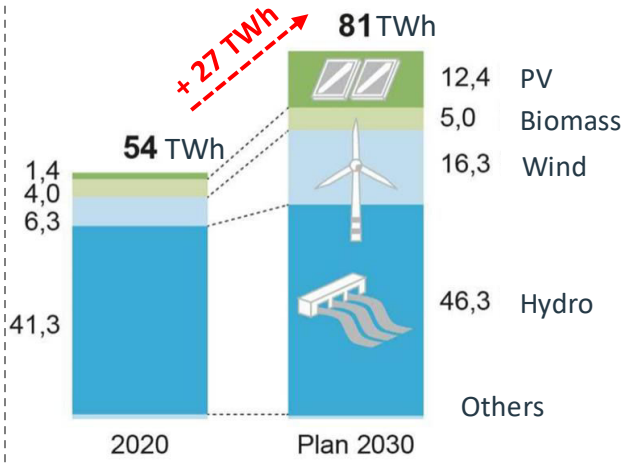
Source: www.ecomatcher.com

„In the next decade or two, the economic damage caused by climate change will likely be as bad as having a COVID-sized pandemic every ten years."
(Bill Gates)

[1] GatesNotes: https://www.gatesnotes.com/Energy/Climate-and-COVID-19

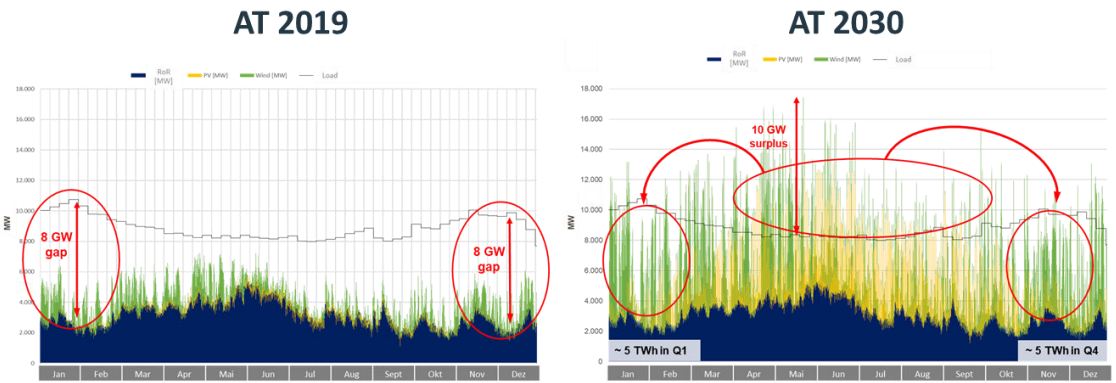
Austrian electricity production will become more dynamic

Energy (TWh)



Source: APA/ Standard

Power (GW)



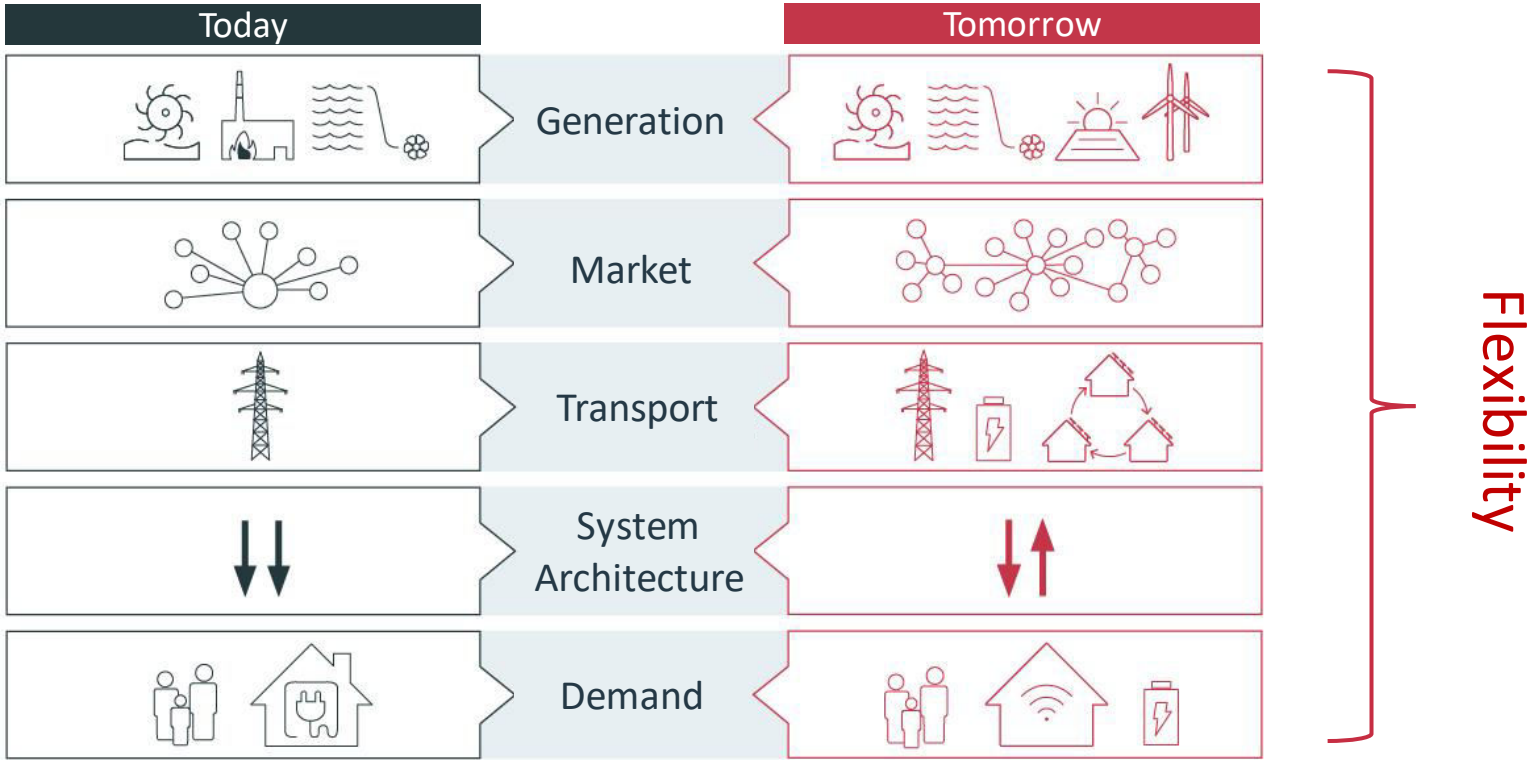
Wind	3,2 GW	9 GW
PV	1,6 GW	12 GW

→ **flexibility management (Flex-Hub)[1]**

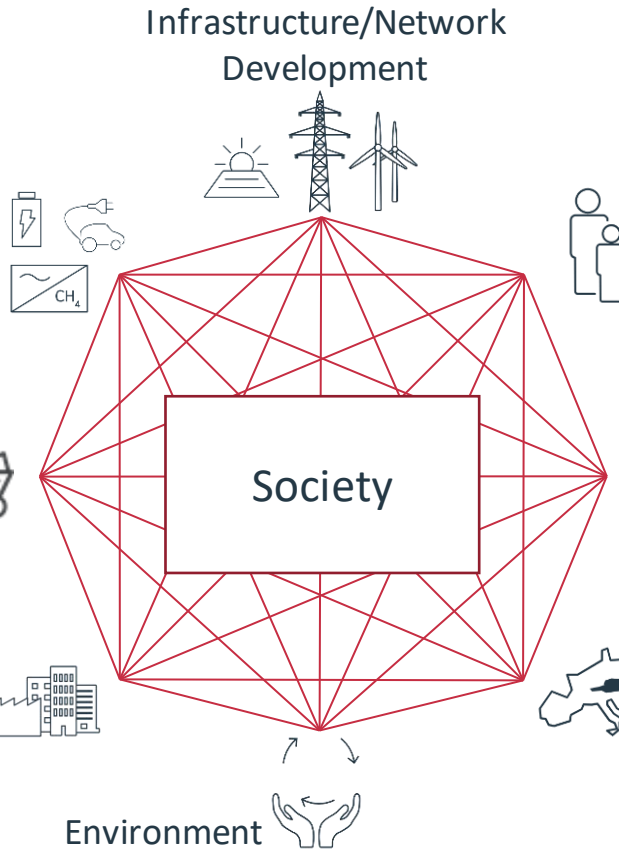
→ **seasonal energy storage (P2G Sector Coupling)[1]**

Input Data: TU Wien; Stromzukunft Österreich 2030; Mai 2017 and APG simulations | [1] APG Projects

The electricity system today and tomorrow



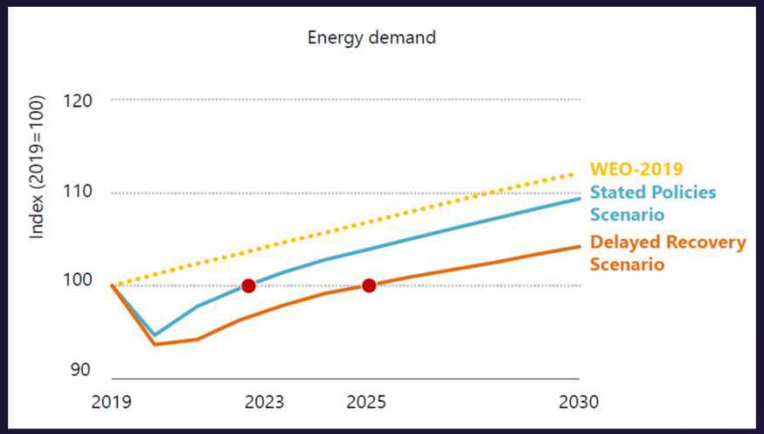
Courage to change

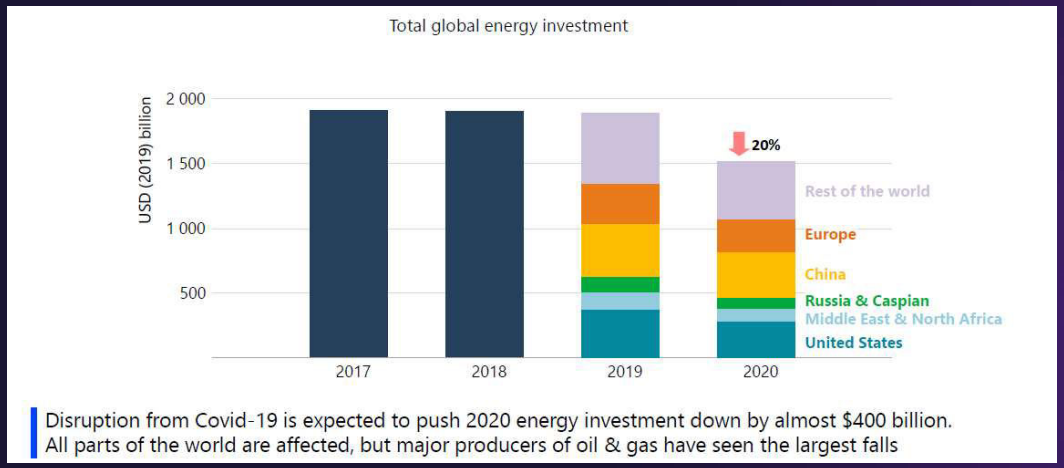


3rd Vienna Energy Strategy Dialogue

November 24, 2020

Global effects of the COVID-19 pandemic on the Energy Sector





Disruption from Covid-19 is expected to push 2020 energy investment down by almost $400 billion. All parts of the world are affected, but major producers of oil & gas have seen the largest falls

Source: IEA World Energy Outlook 2020

Short-term Impact

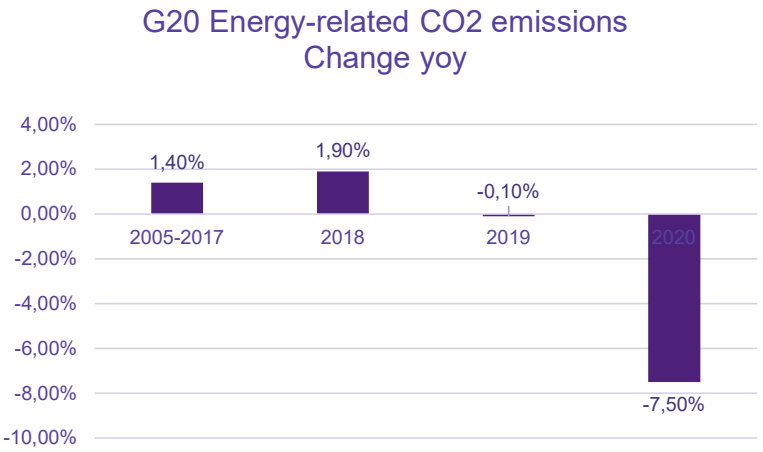
- Demand down
- Oil/Gas price down
- Less investment in O&G and Power; transmission only little affected
- Higher dispatch of renewables, less fossil
- **Coal-to-Gas** shift in dispatch due to lower gas prices
- Emission reduction
- ETS price volatile 15-30 €/tCO_2
- Cost of integration of renewables into the energy system surging

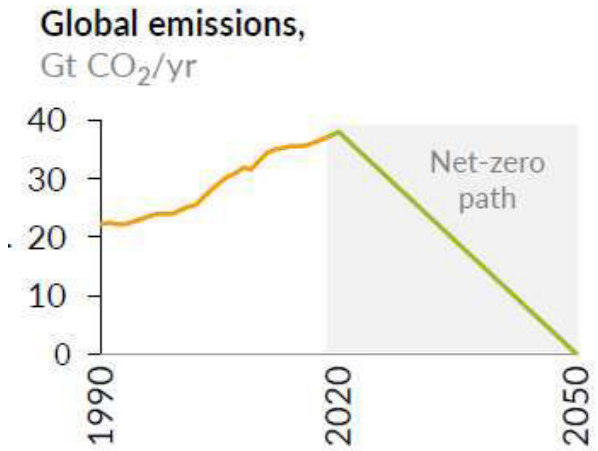
Long-term Impact

- Demand increase ? → Sector Coupling
- Policy shift towards decarbonization and climate neutrality
- Peak oil?
- Investment in Power-to-X and hydrogen infrastructure
- New regulation:
  - Carbon border adjustment tax
  - EU Taxonomy
- Security of supply

Source: IEA WEO-2020; Climate Transparency Report 2020

The Global Energy Transition During & After COVID





- Renewables in G20 projected to increase to **28%** of power generation in 2020 (27% 2019, 25% in 2018)
- COVID-19 economic stimulus packages across the G20 total EUR **10+tn**
- 17 G20 countries are providing some support to green industries
- **A green recovery** can protect sustainable development pathways and contribute to meeting climate goals

Source: The Climate Transparency Report 2020; Global Carbon Project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In addition to sustainability, energy systems have to meet societal needs for availability and affordability.

Technology advancing: persistent cost decline comes with new opportunities to integrate renewables

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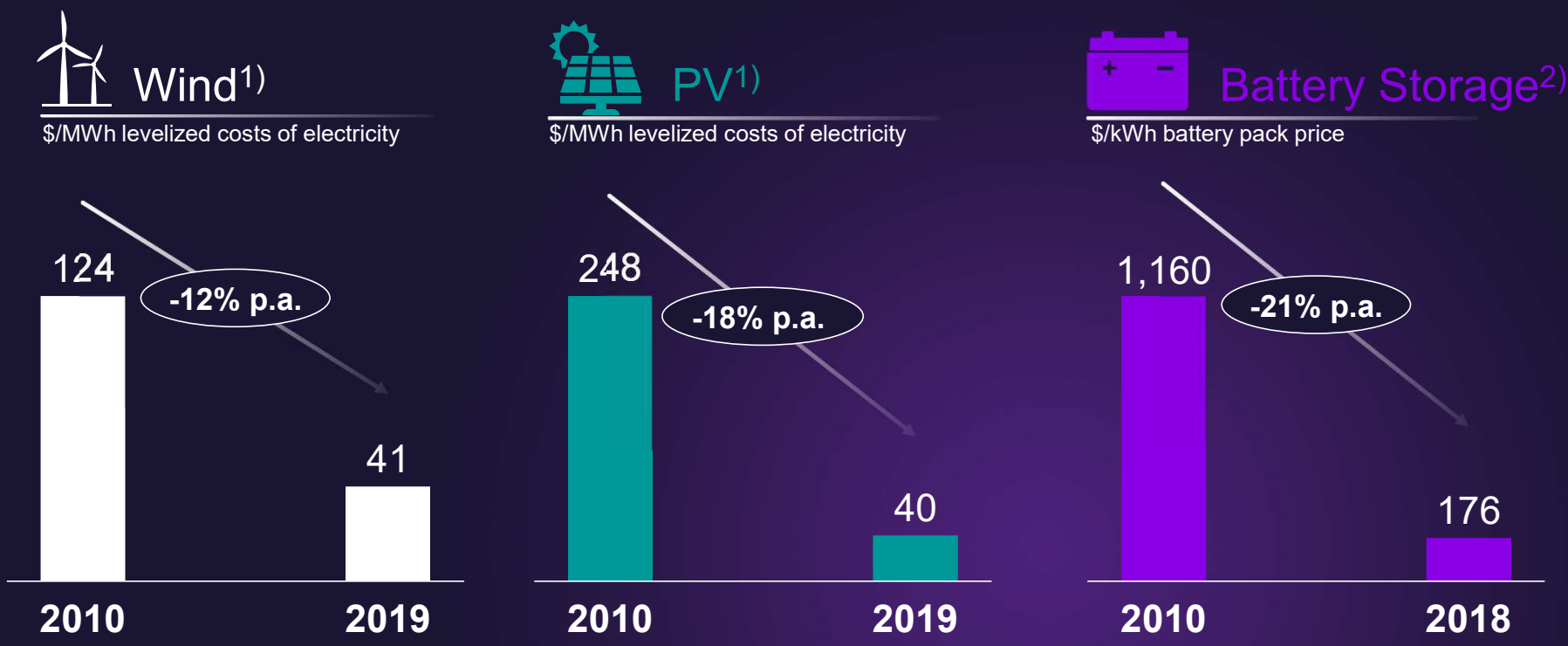
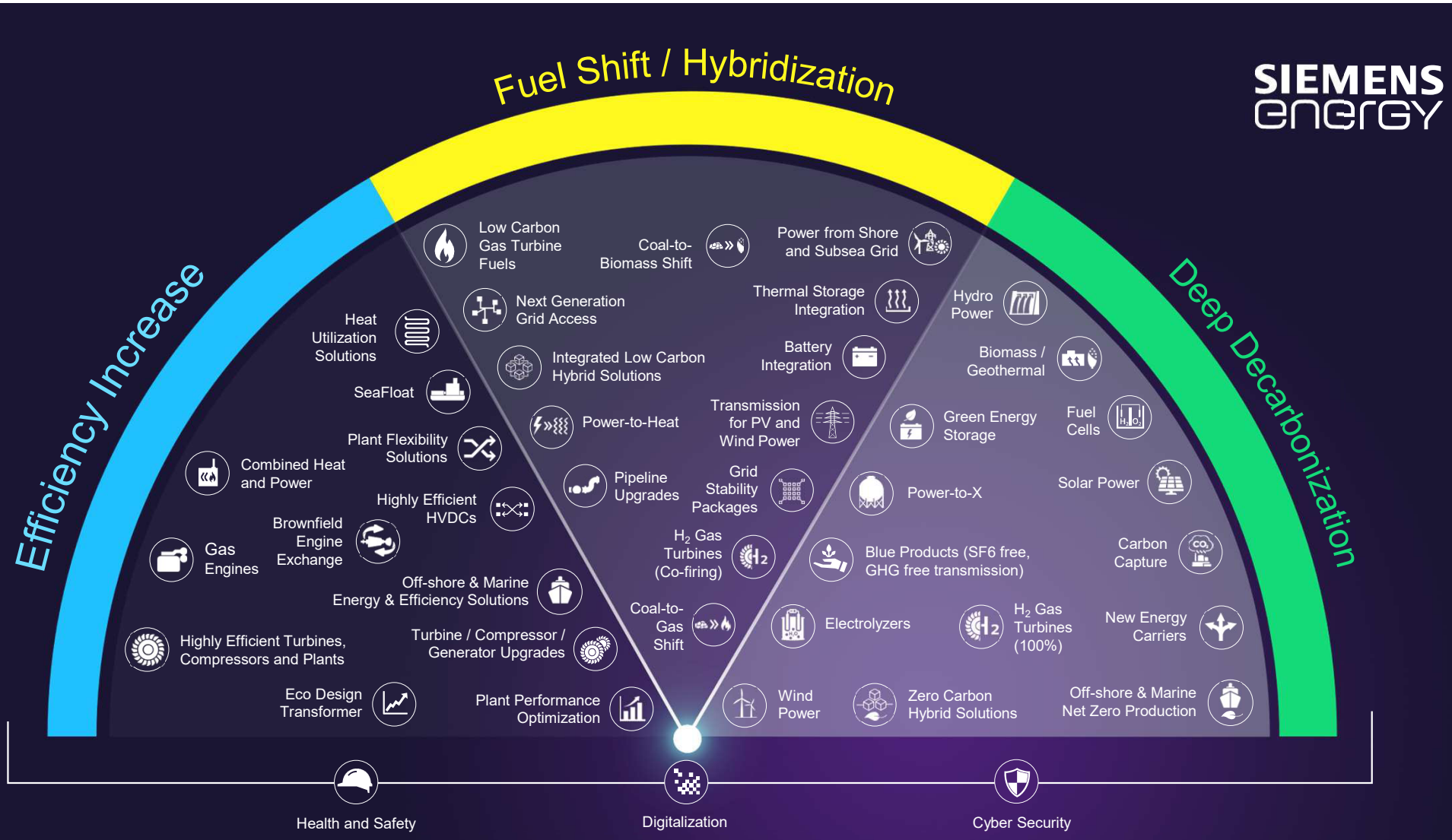


1) Levelized cost of electricity $/MWh average value of range, Lazard's latest annual Levelized Cost of Energy Analysis 13.0; https://www.lazard.com/perspective/lcoe2019,
2) Lithium-ion battery price survey, battery pack price $/kWh, https://about.bnef.com/blog/behind-scenes-take-lithium-ion-battery-prices/

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The best way
to predict the
future of energy
is to shape it.